

# SciKGT<sub>e</sub>X: A LaTeX Package for FAIR-Annotated Publications

**Oliver Karras, Alessio Ferrari, Davide Fucci, and Davide Dell'Anna**

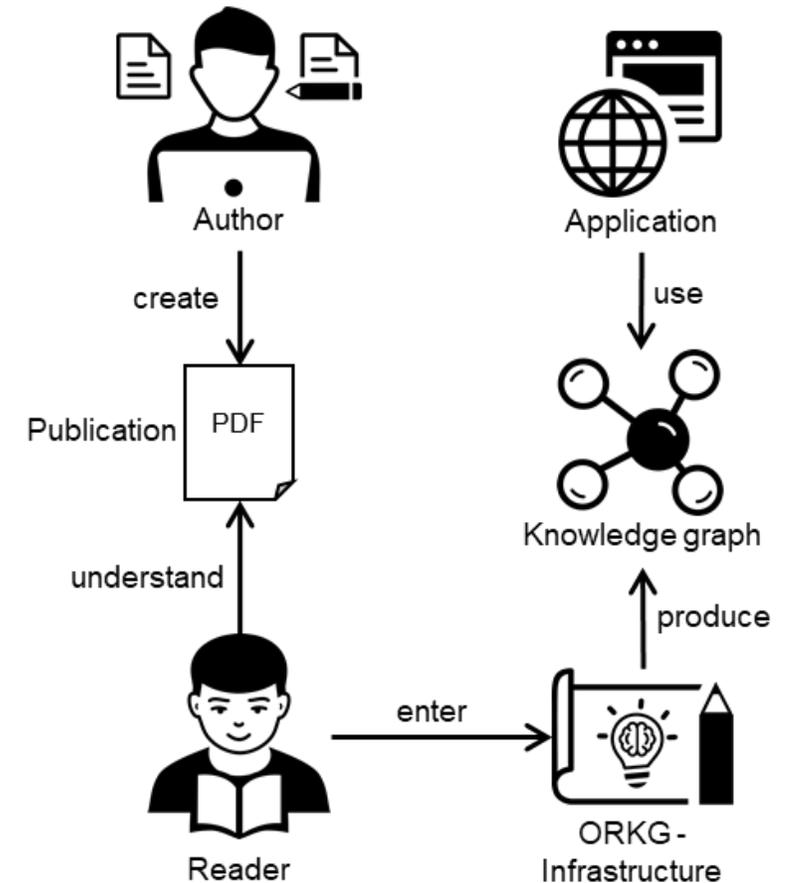
[oliver.karras@tib.eu](mailto:oliver.karras@tib.eu), [alessio.ferrari@isti.cnr.it](mailto:alessio.ferrari@isti.cnr.it), [davide.fucci@bth.se](mailto:davide.fucci@bth.se), [d.dellanna@uu.nl](mailto:d.dellanna@uu.nl)

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June 24<sup>th</sup>, 2024, Reykjavik, Iceland

# Problem: Making Publications FAIR is a Downstream Task

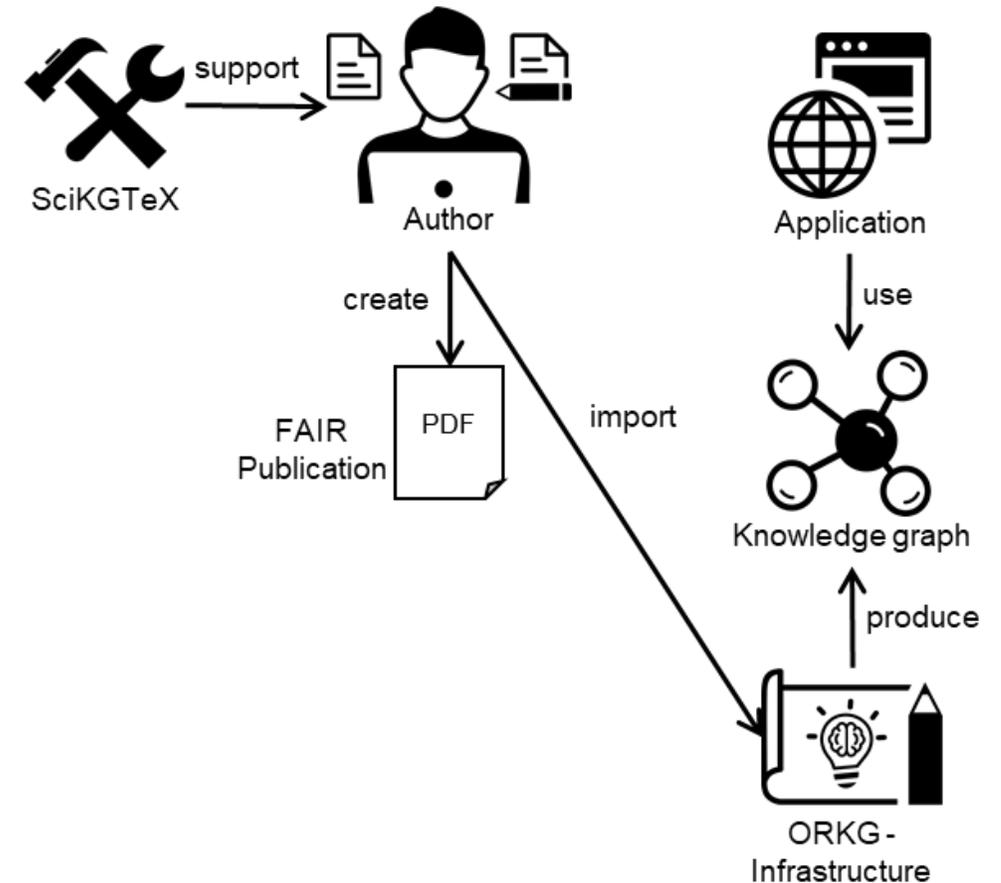
**Problem:** ORKG focuses on **published** articles, so making them **FAIR** is a **downstream task** and often **not done by the author**.



# Solution: “FAIR-by-Design” Artifacts and SciKGTex<sup>[8]</sup>

**Solution:** “FAIR-by-Design” Artifacts.  
**SciKGTex** supports authors in making their publication **FAIR** at the time of **creation**.

- **Authors describe** their publication with FAIR information **only once** and **in parallel** at the time of **creation**
- **SciKGTex embeds** FAIR information into the **PDF metadata** as a knowledge graph
  - **Persistent** over PDF lifetime
  - **Available** for anyone
  - **Reusable**, e.g., import into ORKG



# SciKGT<sub>E</sub>X – Scientific Knowledge Graph TeX

- Predefined commands for annotation
  - 3 commands for metadata
    - Title
    - Author
    - Research field
  - 5 commands for content
    - Research problem
    - Objective
    - Method
    - Result
    - Conclusion
- Support for own custom annotations
  - REFSQ'24 and REFSQ'25 ask for
    - Code repository
    - Dataset

```
\usepackage{scikgtex}
```

```
\begin{document}
```

The role of `\researchproblem{antibiotic therapy}` is controversial. The purpose of this study was to `\objective{determine the effectiveness of high-dose amoxicillin/potassium clavulanate in the treatment of children}`.

This was a `\method{randomized, double-blind, placebo-controlled study}`.

`\result{Children receiving the antibiotic were more likely to be cured (50% vs 14%) than children receiving the placebo}`.

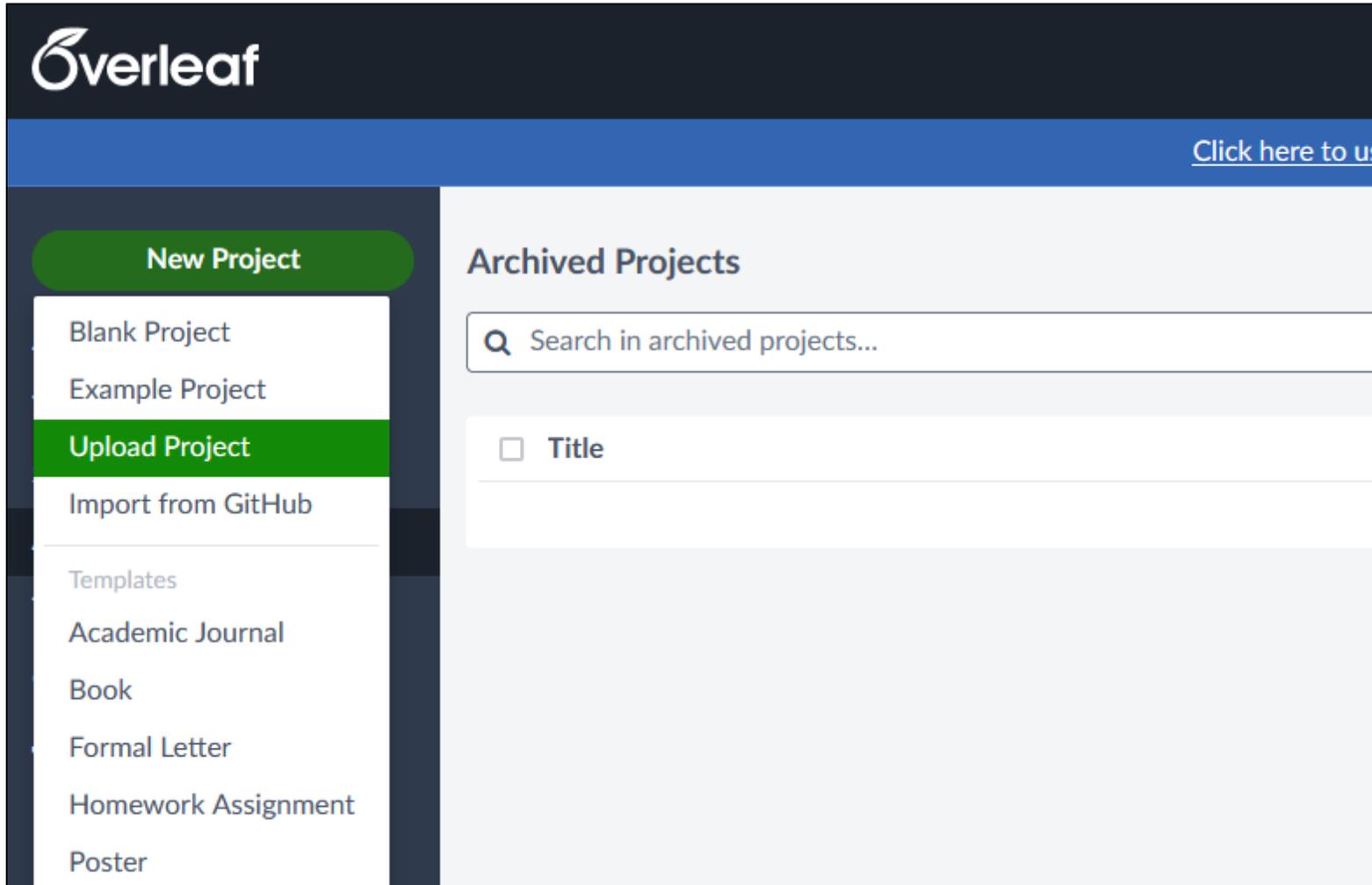
`\conclusion{Amoxicillin/potassium clavulanate results in significantly more cures and fewer failures than placebo}`.

```
\end{document}
```

**Complete documentation and latest version:**

<https://github.com/Christof93/SciKGT<sub>E</sub>X>

# Set up a LaTeX Project (using Overleaf)



1. Download Example.zip  
<https://bit.ly/49RjRbO>
2. Open Overleaf  
<https://www.overleaf.com/>
3. Upload Example.zip  
New Project → Upload Project
4. Select or drag zip file

**Remark:**

We only use an abstract for the annotations as a simplified example. Annotations can be used **anywhere** (in one or more LaTeX files).

# 0. Add SciKGT<sub>E</sub>X Files to the Project

The screenshot displays the Overleaf online LaTeX editor. The interface includes a top navigation bar with options like 'Menu', 'Upgrade', 'Review', 'Share', 'Submit', 'History', 'Layout', and 'Chat'. The main workspace is split into two panes:

- Left Pane (Code Editor):** Shows the LaTeX source code for 'example.tex'. The code includes:
 

```

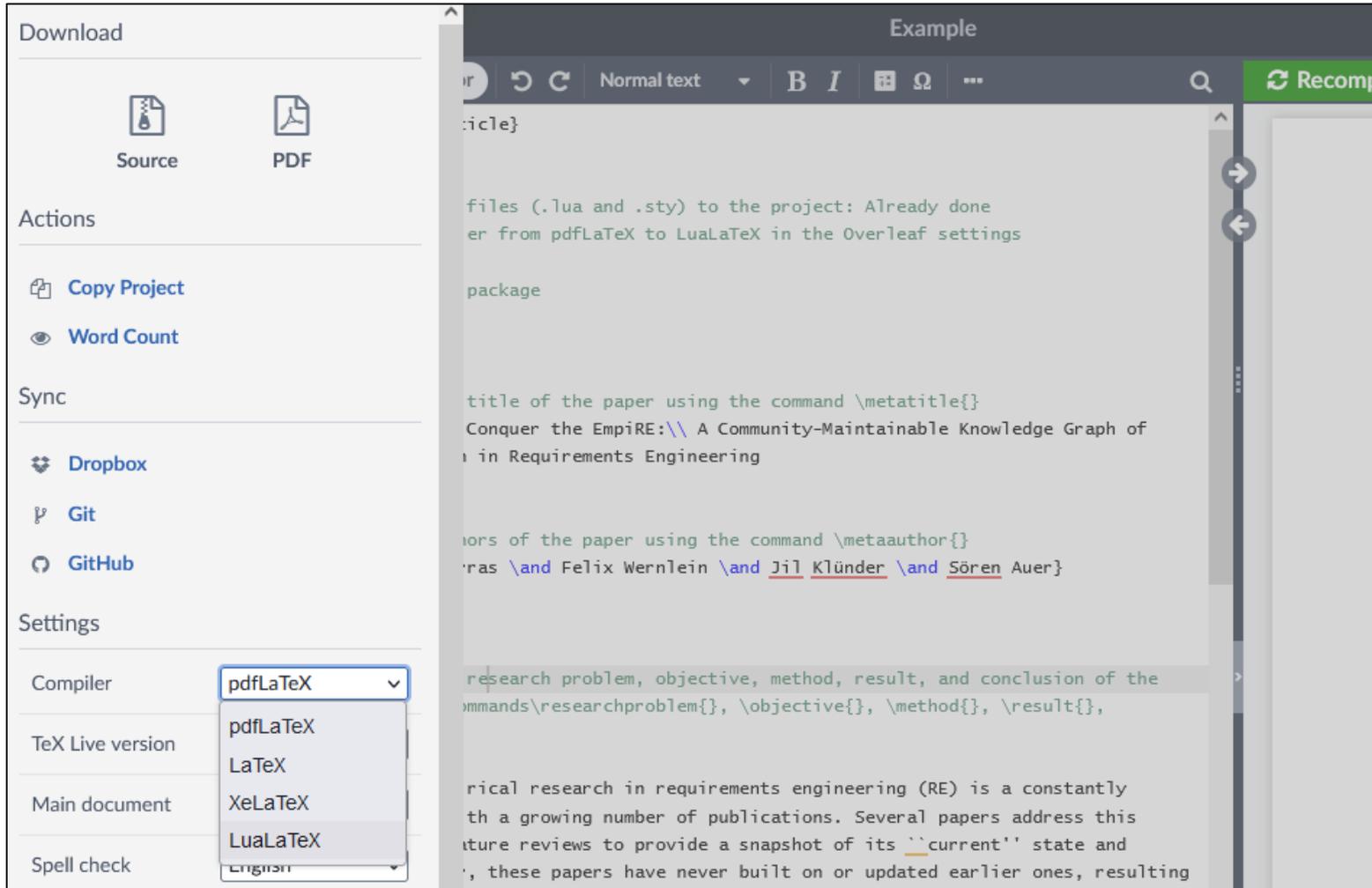
1 \documentclass{article}
2 \usepackage{ur1}
3
4 % 0. Add scikgtex files (.lua and .sty) to the project: Already done
5 % 1. Change compiler from pdfLaTeX to LuaLaTeX in the Overleaf settings
6
7 % 2. Add SciKGTEX package
8
9 \begin{document}
10
11 % 3. Annotate the title of the paper using the command \metatitle{}
12 \title{Divide and Conquer the EmpiRE: A Community-Maintainable Knowledge Graph
13 of Empirical Research in Requirements Engineering}
14 }
15
16 % 4. Annotate authors of the paper using the command \metaauthor{}
17 \author{Oliver Karras \and Felix Wernlein \and Jil Klünder \and Sören Auer}
18
19 \maketitle
20
21 % 5. Annotate the research problem, objective, method, result, and conclusion of
22 the paper using the commands \researchproblem{}, \objective{}, \method{},
23 \result{}, \conclusion{}
24
25 \begin{abstract}
26 [Background.] Empirical research in requirements engineering (RE) is a constantly
27 evolving topic, with a growing number of publications. Several papers address this
28 topic using literature reviews to provide a snapshot of its "current" state and
29 evolution. However, these papers have never built on or updated earlier ones,
30 resulting in overlap and redundancy. The underlying problem is the unavailability
31 of data from earlier works. Researchers need technical infrastructures to conduct
32 sustainable literature reviews. [Aims.] We examine the use of the Open Research
33 Knowledge Graph (ORKG) as such an infrastructure to build and publish an initial
34 Knowledge Graph of Empirical research in RE (KG-EmpIRE) whose data is openly
35 available. Our long-term goal is to continuously maintain KG-EmpIRE with the
36 research community to synthesize a comprehensive, up-to-date, and long-term
37 available overview of the state and evolution of empirical research in RE.
38 [Method.] We conduct a literature review using the ORKG to build and publish KG-
39 EmpIRE which we evaluate against competency questions derived from a published
40 vision of empirical research in software (requirements) engineering for 2020 --
41 2025. [Results.] From 570 papers of the IEEE International Requirements
42 Engineering Conference (2000 -- 2022), we extract and analyze data on the reported
43 empirical research and answer 16 out of 77 competency questions. These answers
44 show a positive development towards the vision, but also the need for future
45 sustainable literature reviews.
46 \end{abstract}
47 \end{document}

```
- Right Pane (Rendered PDF):** Shows the compiled document. The title is "Divide and Conquer the EmpiRE: A Community-Maintainable Knowledge Graph of Empirical Research in Requirements Engineering". The authors listed are Oliver Karras, Felix Wernlein, Jil Klünder, and Sören Auer. The date is April 18, 2024. The abstract text is visible below the title.

The following two files must be present:

- scikgtex.lua
- scikgtex.sty

# 1. Change Compiler from pdfLaTeX to LuaLaTeX



It is necessary to compile your LaTeX source with **LuaLaTeX** for the SciKGT<sub>E</sub>X package to work.

## 2. Add the SciKGT<sub>E</sub>X Package to the LaTeX File

```
1 \documentclass{article}
2 \usepackage{url}
3
4 % 0. Add scikgtex files (.lua and .sty) to the project: Already done
5 % 1. Change compiler from pdfLaTeX to LuaLaTeX in the Overleaf settings
6
7 % 2. Add SciKGTEX package
8
9
10 \begin{document}
11
```

Add the command to the preamble of the LaTeX file:

```
\usepackage{scikgtex}
```

## 2. Add the SciKGT<sub>E</sub>X Package to the LaTeX File: Result

```
1 \documentclass{article}
2 \usepackage{url}
3
4 % 0. Add scikgtex files (.lua and .sty) to the project: Already done
5 % 1. Change compiler from pdfLaTeX to LuaLaTeX in the Overleaf settings
6
7 % 2. Add SciKGTEX package
8 \usepackage{scikgtex}
9
10 \begin{document}
11
```

Add the command to the preamble of the LaTeX file:

```
\usepackage{scikgtex}
```

## 3. & 4. Annotate Metadata of the Paper

```
10 ▾ \begin{document}
11
12 % 3. Annotate the title of the paper using the command \metatitle{}
13 ▾ \title{Divide and Conquer the EmpiRE:\\ A Community-Maintainable Knowledge Graph of
    Empirical Research in Requirements Engineering
14 }
15
16 % 4. Annotate authors of the paper using the command \metaauthor{}
17 \author{Oliver Karras \and Felix Wernlein \and Jil Klünder \and Sören Auer}
18
19 \maketitle
20
```

1. Annotate the title  
`\metatitle{}`
2. Annotate the authors  
`\metaauthor{}`

### Remark:

The command `\metaauthor{}` must be used individually **for each author**. With four authors, you need the command four times.

## 3. & 4. Annotate Metadata of the Paper: Result

```
10 ▾ \begin{document}
11
12 % 3. Annotate the title of the paper using the command \metatitle{}
13 ▾ \title{\metatitle{Divide and Conquer the Empire:\\ A Community-Maintainable Knowledge
    Graph of Empirical Research in Requirements Engineering}
14 }
15
16 % 4. Annotate authors of the paper using the command \metaauthor{}
17 \author{\metaauthor{Oliver Karras} \and \metaauthor{Felix Wernlein} \and
    \metaauthor{Jil Klünder} \and \metaauthor{Sören Auer}}
18
19 \maketitle
20
```

1. Annotate the title  
`\metatitle{}`
2. Annotate the authors  
`\metaauthor{}`

### Remark:

The command `\metaauthor{}` must be used individually **for each author**. With four authors, you need the command four times.

## 5. Annotate Content of the Paper

```
21 % 5. Annotate the research problem, objective, method, result, and conclusion of the
    paper using the commands\researchproblem{}, \objective{}, \method{}, \result{},
    \conclusion{}
22 \begin{abstract}
23 [Background.] Empirical research in requirements engineering (RE) is a constantly
    evolving topic, with a growing number of publications. Several papers address this
    topic using literature reviews to provide a snapshot of its ``current'' state and
    evolution. However, these papers have never built on or updated earlier ones, resulting
    in overlap and redundancy. The underlying problem is the unavailability of data from
    earlier works. Researchers need technical infrastructures to conduct sustainable
    literature reviews. [Aims.] We examine the use of the Open Research Knowledge Graph
    (ORKG) as such an infrastructure to build and publish an initial Knowledge Graph of
    Empirical research in RE (KG-EmpIRE) whose data is openly available. Our long-term goal
    is to continuously maintain KG-EmpIRE with the research community to synthesize a
    comprehensive, up-to-date, and long-term available overview of the state and evolution
    of empirical research in RE. [Method.] We conduct a literature review using the ORKG
    to build and publish KG-EmpIRE which we evaluate against competency questions derived from
    a published vision of empirical research in software (requirements) engineering for
    2020 -- 2025. [Results.] From 570 papers of the IEEE International Requirements
    Engineering Conference (2000 -- 2022), we extract and analyze data on the reported
    empirical research and answer 16 out of 77 competency questions. These answers show a
    positive development towards the vision, but also the need for future improvements.
    [Conclusions.] The ORKG is a ready-to-use and advanced infrastructure to organize data
    from literature reviews as knowledge graphs. The resulting knowledge graphs make the
    data openly available and maintainable by research communities, enabling sustainable
    literature reviews.
24 \end{abstract}
```

1. Annotate the research problem  
`\researchproblem{}`
2. Annotate the objective  
`\objective{}`
3. Annotate the method  
`\method{}`
4. Annotate the result  
`\result{}`
5. Annotate the conclusion  
`\conclusion{}`

## 5. Annotate Content of the Paper

21 % 5. Annotate the research problem, objective, method, result, and conclusion of the

### Remark:

- All commands can be used **multiple** times.
- The annotated text elements should be as **short** as **possible** and as **long** as **necessary**.
- Definitions:
  - **Research problem**: Issue or gap in existing knowledge addressed by the paper.
  - **Objective**: Goal that the paper aims to achieve.
  - **Method**: Systematic approach, technique, or action plan used in the paper to achieve a goal and result.
  - **Result**: Outcome from a systematic approach, technique, or action plan used in the paper.
  - **Conclusion**: Findings from the analysis of the research results in the paper.

24 \end{abstract}

1. Annotate the research problem  
`\researchproblem{}`
2. Annotate the objective  
`\objective{}`
3. Annotate the method  
`\method{}`
4. Annotate the result  
`\result{}`
5. Annotate the conclusion  
`\conclusion{}`

## 5. Annotate Content of the Paper: Result

```
21 % 5. Annotate the research problem, objective, method, result, and conclusion of the
    paper using the commands\researchproblem{}, \objective{}, \method{}, \result{},
    \conclusion{}
22 \begin{abstract}
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    EmpiRE with the research community to synthesize a comprehensive, up-to-date, and long-
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    [Method.] We conduct a \method{literature review using the ORKG} to build and publish
    KG-EmpIRE which we \method{evaluate against competency questions} derived from a
    published vision of empirical research in software (requirements) engineering for 2020
    -- 2025. [Results.] \result{From 570 papers of the IEEE International Requirements
    Engineering Conference (2000 -- 2022), we extract and analyze data on the reported
    empirical research} and \result{answer 16 out of 77 competency questions}. These
    answers show a positive development towards the vision, but also the need for future
    improvements. [Conclusions.] \conclusion{The ORKG is a ready-to-use and advanced
    infrastructure to organize data from literature reviews as knowledge graphs}. The
    resulting knowledge graphs make the data openly available and maintainable by research
    communities, enabling sustainable literature reviews.
24 \end{abstract}
```

1. Annotate the research problem

`\researchproblem{}`

2. Annotate the objective

`\objective{}`

3. Annotate the method

`\method{}`

4. Annotate the result

`\result{}`

5. Annotate the conclusion

`\conclusion{}`

## 6. Annotate Content of the Paper with Invisible Markup

```

21 % 5. Annotate the research problem, objective, method, result, and conclusion of the
    paper using the commands\researchproblem{}, \objective{}, \method{}, \result{},
    \conclusion{}
22 \begin{abstract}
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    infrastructure to organize data from literature reviews as knowledge graphs}. The
    resulting knowledge graphs make the data openly available and maintainable by research
    communities, enabling sustainable literature reviews.
24 \end{abstract}

```

What can I do, if the text is not suitable for annotation?

**Example:**

“... \method{evaluate against competency questions} ...”

**Solution:**

\method\*{evaluation against competency questions}

**Remark:**

This text is added to the PDF metadata, but **not rendered** in the text of the PDF.

## 6. Annotate Content of the Paper with Invisible Markup: Result

```

21 % 5. Annotate the research problem, objective, method, result, and conclusion of the
    paper using the commands\researchproblem{}, \objective{}, \method{}, \result{},
    \conclusion{}
22 \begin{abstract}
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    evolving topic, with a growing number of publications. Several papers address this
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    available}. Our long-term goal is to continuously maintain KG-EmpIRE with the research
    community to synthesize a comprehensive, up-to-date, and long-term available overview
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    research in software (requirements) engineering for 2020 -- 2025. [Results.]
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    (2000 -- 2022), we extract and analyze data on the reported empirical research} and
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    organize data from literature reviews as knowledge graphs}. The resulting knowledge
    graphs make the data openly available and maintainable by research communities,
    enabling sustainable literature reviews.
24 \end{abstract}
25
26 % 6. If written text is not suitable for annotation, we can also annotate invisible
    text using the *-notation
27 \researchproblem*{unavailability of the extracted and analyzed data from literature
    reviews}
28 \method*{evaluation against competency questions}

```

What can I do, if the text is not suitable for annotation?

**Example:**

“... \method{evaluate against competency questions} ...”

**Solution:**

\method\*{evaluation against competency questions}

**Remark:**

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# Comparison of Annotated Paper Versions

```

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23 [Background.] Empirical research in requirements engineering (RE) is a constantly
    evolving topic, with a growing number of publications. Several papers address this
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    evolution. However, these papers have never built on or updated earlier ones, resulting
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    term available overview of the state and evolution of empirical research in RE.
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    answers show a positive development towards the vision, but also the need for future
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    infrastructure to organize data from literature reviews as knowledge graphs}. The
    resulting knowledge graphs make the data openly available and maintainable by research
    communities, enabling sustainable literature reviews.
24 \end{abstract}
  
```

```

21 % 5. Annotate the research problem, objective, method, result, and conclusion of the
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    evolving topic, with a growing number of publications. Several papers address this
    topic using literature reviews to provide a snapshot of its ``current'' state and
    evolution. However, these papers have never built on or updated earlier ones, resulting
    in overlap and redundancy. The underlying problem is the unavailability of data from
    earlier works. Researchers need technical infrastructures to conduct sustainable
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    Knowledge Graph (ORKG) as such an infrastructure to build and publish an initial
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    available}. Our long-term goal is to continuously maintain KG-EmpIRE with the research
    community to synthesize a comprehensive, up-to-date, and long-term available overview
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    \method[literature review using the ORKG] to build and publish KG-EmpIRE which we
    evaluate against competency questions derived from a published vision of empirical
    research in software (requirements) engineering for 2020 -- 2025. [Results.]
    \result{From 570 papers of the IEEE International Requirements Engineering Conference
    (2000 -- 2022), we extract and analyze data on the reported empirical research} and
    \result{answer 16 out of 77 competency questions}. These answers show a positive
    development towards the vision, but also the need for future improvements.
    [Conclusions.] \conclusion{The ORKG is a ready-to-use and advanced infrastructure to
    organize data from literature reviews as knowledge graphs}. The resulting knowledge
    graphs make the data openly available and maintainable by research communities,
    enabling sustainable literature reviews.
24 \end{abstract}
25
26 % 6. If written text is not suitable for annotation, we can also annotate invisible
    text using the *-notation
27 \researchproblem*{unavailability of the extracted and analyzed data from literature
    reviews}
28 \method*{evaluation against competency questions}
  
```

## 7. (Optional) Annotate Research Field

### Remark:

1. A paper in the ORKG is assigned to a research field based on the DFG classification. All research fields: <https://orkg.org/fields>.
2. URI of the ORKG semantic web resource for Software Engineering: <https://orkg.org/resource/R140>.
3. Use the command `\uri{"URI"}{"Label"}` inside an annotation to refer to resources in the semantic web. The first argument is the **URI** to the semantic resource and the second is an optional **Label**.
4. The term "Software Engineering" does not appear in the abstract, so we need an **invisible** annotation and we also use the `\uri{}` command to create a reference to the semantic resource.

1. Annotate the research field

`\researchfield{}`

2. Refer to the ORKG semantic web resource [Software Engineering](https://orkg.org/resource/R140)

`\uri{"URI"}{"Label"}`

## 7. (Optional) Annotate Research Field: Result

```
29 % 7. Optional: Annotate research field of the paper
30 \researchfield*{\uri{https://orkg.org/resource/R140}{Software Engineering}}
```

### Remark:

1. A paper in the ORKG is assigned to a research field based on the DFG classification. All research fields: <https://orkg.org/fields>.
2. URI of the ORKG semantic web resource for Software Engineering: <https://orkg.org/resource/R140>.
3. Use the command `\uri{“URI”}{“Label”}` inside an annotation to refer to resources in the semantic web. The first argument is the **URI** to the semantic resource and the second is an optional **Label**.
4. The term “Software Engineering” does not appear in the abstract, so we need an **invisible** annotation and we also use the `\uri{}` command to create a reference to the semantic resource.

1. Annotate the research field

`\researchfield{}`

2. Refer to the ORKG semantic web resource [Software Engineering](https://orkg.org/resource/R140)

`\uri{“URI”}{“Label”}`

## 8. Use Custom Annotations of REFSQ'24 and REFSQ'25

```
33 % 8. Optional: Using REFSQ'24 and REFSQ'25 annotations
34 \contribution*{code repository}{\url{https://github.com/okarras/EmpIRE-Analysis}}
35 \contribution*{dataset}{\url{https://orkg.org/api/rdf/dump}}
36
37 \end{document}
```

### Remark:

1. Use the command `\contribution{"Property name"}{"Label"}` to add a custom annotation for your domain. The first argument is the **Property name** of the property from the ORKG you want to use, and the second is an optional **Label**. SciKGT<sub>EX</sub> checks if a property with the provided exact **Property name** exists and replaces it with the internal property ID in the ORKG namespace.
2. All ORKG properties can be found here: <https://orkg.org/properties>.

1. Annotate the code repository

`\contribution{code repository}{}`

2. Annotate the dataset

`\contribution{dataset}{}`

# 9. Generate FAIR-Annotated PDF of the Paper

The screenshot displays a LaTeX editor interface. On the left, the code editor shows the following LaTeX source code:

```

1 \documentclass{article}
2 \usepackage{ur}
3
4 % 0. Add scikgtex files (.lua and .sty) to the project: Already done
5 % 1. Change compiler from pdfLaTeX to LuaLaTeX in the Overleaf settings
6
7 % 2. Add ScikGTEx package
8 \usepackage{scikgtex}
9
10 \begin{document}
11
12 % 3. Annotate the title of the paper using the command \metatitle{}
13 \title{\metatitle{Divide and Conquer the EmpiRE: A Community-Maintainable
14 Knowledge Graph of Empirical Research in Requirements Engineering}
15 }
16
17 % 4. Annotate authors of the paper using the command \metaauthor{}
18 \author{\metaauthor{Oliver Karras} \and \metaauthor{Felix Wernlein} \and
19 \metaauthor{Jil Klünder} \and \metaauthor{Sören Auer}}
20
21 \maketitle
22
23 % 5. Annotate the research problem, objective, method, result, and conclusion of
24 the paper using the commands \researchproblem{}, \objective{}, \method{},
25 \result{}, \conclusion{}
26 \begin{abstract}
27 [Background.] Empirical research in requirements engineering (RE) is a constantly
28 evolving topic, with a growing number of publications. Several papers address this
29 topic using literature reviews to provide a snapshot of its "current" state and
30 evolution. However, these papers have never built on or updated earlier ones,
31 resulting in overlap and redundancy. The underlying problem is the unavailability
32 of data from earlier works. Researchers need technical infrastructures to conduct
33 sustainable literature reviews. [Aims.] We examine the objective{use of the Open
34 Research Knowledge Graph (ORKG) as such an infrastructure to build and publish an
35 initial Knowledge Graph of Empirical research in RE (KG-EmpIRE) whose data is
36 openly available}. Our long-term goal is to continuously maintain KG-EmpIRE with
37 the research community to synthesize a comprehensive, up-to-date, and long-term
38 available overview of the state and evolution of empirical research in RE.
39 [Method.] We conduct a \method{literature review using the ORKG} to build and
40 publish KG-EmpIRE which we evaluate against competency questions derived from a
41 published vision of empirical research in software (requirements) engineering for
42 2020 -- 2025. [Results.] \result{From 570 papers of the IEEE International
43 Requirements Engineering Conference (2000 -- 2022), we extract and analyze data on

```

The preview window on the right shows the rendered PDF output. The title is "Divide and Conquer the EmpiRE: A Community-Maintainable Knowledge Graph of Empirical Research in Requirements Engineering". The authors are "Oliver Karras, Felix Wernlein, Jil Klünder, Sören Auer". The date is "April 19, 2024". The abstract text is also visible in the preview.

Simply...  
**recompile**

**Remark:**  
Each recompile  
adds the  
annotations to the  
metadata of the  
generated PDF.

# 9. Generate FAIR-Annotated PDF of the Paper

The screenshot shows a LaTeX editor interface with a document being compiled. The document content includes:

```

1 \documentclass{article}
2 \usepackage{ur}
3
4 % 0. Add scikgtex files (.lua and .sty) to the project: Already done
5 % 1. Change compiler from pdfLaTeX to LuaLaTeX in the Overleaf settings
6
7 % 2. Add SciKGTex package
8 \usepackage{scikgtex}
9
10 \begin{document}
11
12 % 3. Annotate the title of the paper using the command \metatitle{}
13 \title{\metatitle{Divide and Conquer the EMPIRE: A Community-Maintainable
14 Knowledge Graph of Empirical Research in Requirements Engineering}
15 }
16
17 % 4. Annotate authors of the paper using the command \metaauthor{}
18 \author{\metaauthor{Oliver Karras} \and \metaauthor{Felix Wernlein} \and
19 \metaauthor{Jiri Klunder} \and \metaauthor{Soren Auer}}
20
21 \maketitle
22
23 % 5. Annotate the research problem, objective, method, result, and conclusion of
24 the paper using the commands \researchproblem{}, \objective{}, \method{},
25 \result{}, \conclusion{}
26 \begin{abstract}
27 [Background.] Empirical research in requirements engineering (RE) is a constantly
28 evolving topic, with a growing number of publications. Several papers address this
29 topic using literature reviews to provide a snapshot of its ``current'' state and
30 evolution. However, these papers have never built on or updated earlier ones,
31 resulting in overlap and redundancy. The underlying problem is the unavailability
32 of data from earlier works. Researchers need technical infrastructures to conduct
33 sustainable literature reviews. [Aims.] We examine the use of the Open Research
34 Knowledge Graph (ORKG) as such an infrastructure to build and publish an initial
35 Knowledge Graph of Empirical research in RE (KG-EMPIRE) whose data is openly
36 available. Our long-term goal is to continuously maintain KG-EMPIRE with the
37 research community to synthesize a comprehensive, up-to-date, and long-term
38 available overview of the state and evolution of empirical research in RE.
39 [Method.] We conduct a literature review using the ORKG to build and publish KG-
40 EMPIRE which we evaluate against competency questions derived from a published
41 vision of empirical research in software (requirements) engineering for 2020 --
42 2025. [Results.] From 570 papers of the IEEE International Requirements
43 Engineering Conference (2000 -- 2022), we extract and analyze data on the reported

```

On the right side of the editor, there are five orange warning messages:

- Package SciKGTex Warning: No researchproblem annotation found! Are you sure you don't want to mark an entity with researchproblem?
- Package SciKGTex Warning: No objective annotation found! Are you sure you don't want to mark an entity with objective?
- Package SciKGTex Warning: No method annotation found! Are you sure you don't want to mark an entity with method?
- Package SciKGTex Warning: No result annotation found! Are you sure you don't want to mark an entity with result?
- Package SciKGTex Warning: No conclusion annotation found! Are you sure you don't want to mark an entity with conclusion?

Below the warnings is a "Raw logs" section showing the compilation output:

```

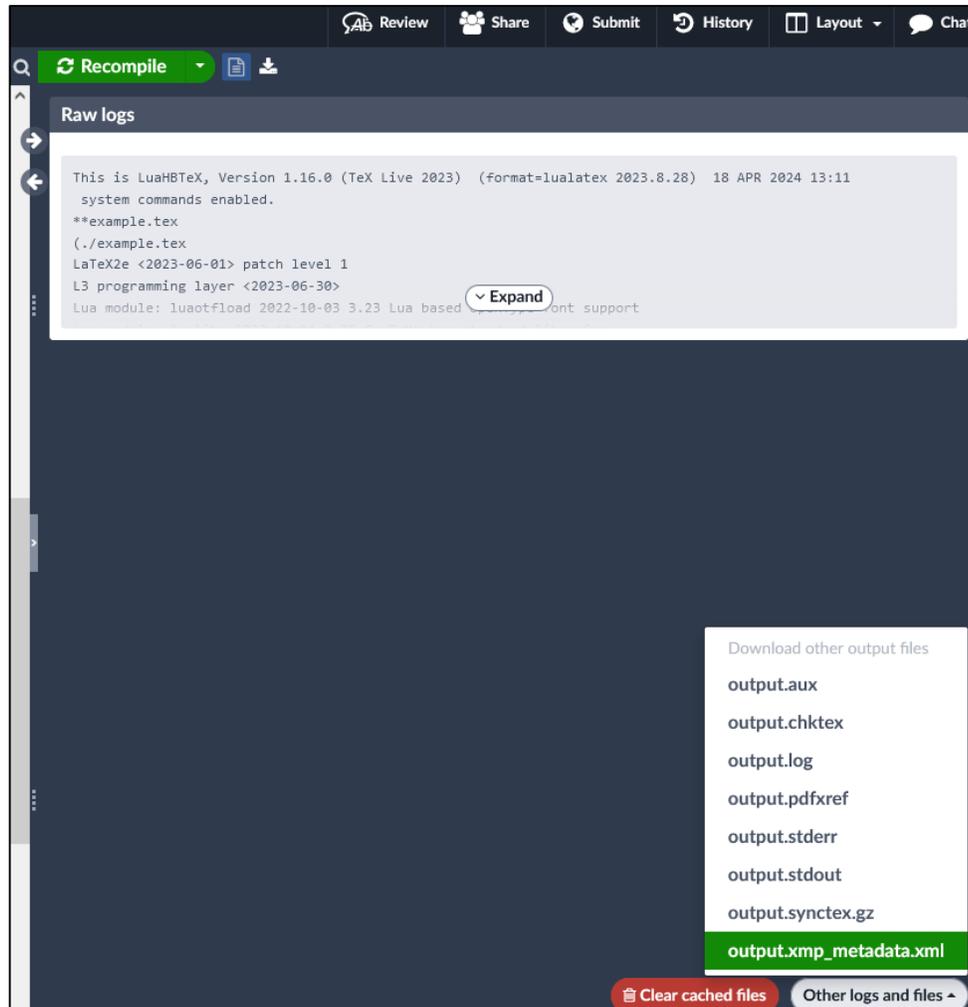
This is LuaHBTeX, Version 1.16.0 (TeX Live 2023) (format=lualatex 2023.8.28) 19 APR 2024 06:36
system commands enabled.
**example.tex
(./example.tex
LaTeX2e <2023-06-01> patch level 1
L3 programming layer <2023-06-30>
Lua module: luaotfload 2022-10-03 3.23 Lua base font support

```

At the bottom right, there are buttons for "Clear cached files" and "Other logs and files".

For the 5 predefined commands for content, SciKGTex also provides **warnings** if an annotation is missing.

# 10. Check the FAIR information embedded in the PDF



1. Open “Logs and outputs files”
2. Select “Other logs and files”
3. Download “output.xmp\_metadata.xml”
4. Open “output.xmp\_metadata.xml”

## Remark:

We only use an abstract for the annotations as a simplified example. Annotations can be used **anywhere** (in one or more LaTeX files).

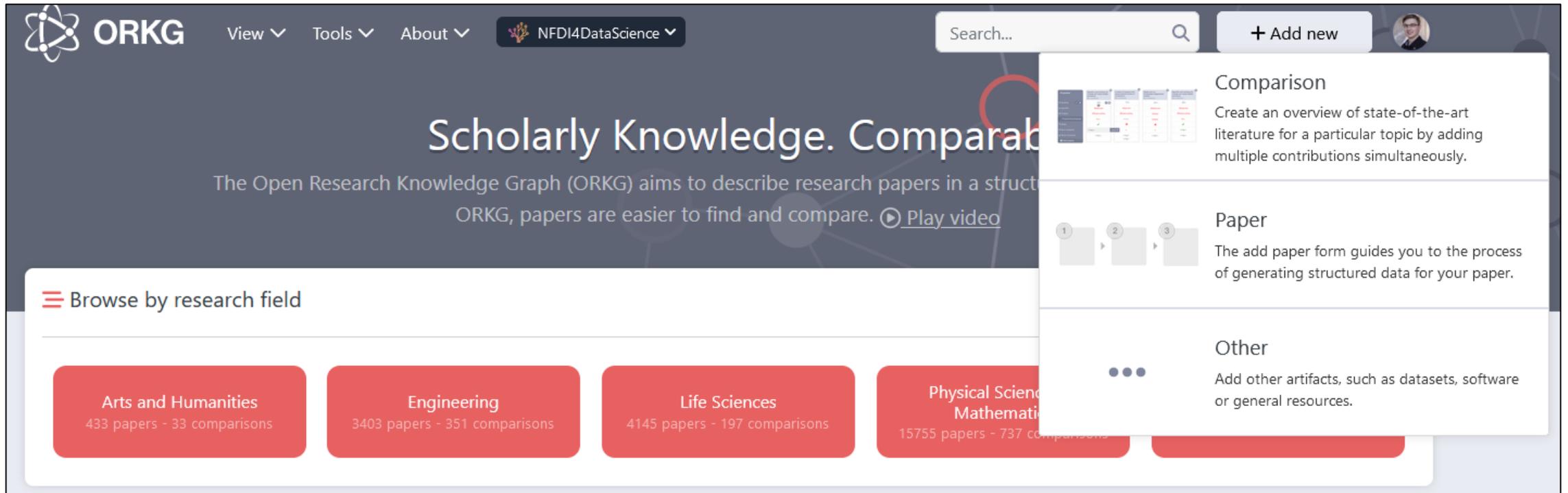
# 10. Check the FAIR information embedded in the PDF

```

<?xpacket begin="?" id="a7c48312-233b-400b-c0f3-0c296941c6"?>
▼<x:xmpmeta xmlns:x="adobe:ns:meta/">
  ▼<rdf:RDF xmlns:orkg="http://orkg.org/core#" xmlns:orkg_property="http://orkg.org/property/" xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#">
    ▼<rdf:Description rdf:about="https://www.orkg.org/orkg/paper/a7c48312-233b-400b-c0f3-0c296941c6">
      <rdf:type rdf:resource="http://orkg.org/core#Paper"/>
      <orkg:hasTitle>Divide and Conquer the EmpiRE: A Community-Maintainable Knowledge Graph of Empirical Research in Requirements
      Engineering</orkg:hasTitle>
      <orkg:hasAuthor>Oliver Karras</orkg:hasAuthor>
      <orkg:hasAuthor>Felix Wernlein</orkg:hasAuthor>
      <orkg:hasAuthor>Jil Klünder</orkg:hasAuthor>
      <orkg:hasAuthor>Sören Auer</orkg:hasAuthor>
    ▼<orkg_property:P30>
      ▼<rdf:Description rdf:about="https://orkg.org/resource/R140">
        <rdfs:label>Software Engineering</rdfs:label>
        </rdf:Description>
      </orkg_property:P30>
    ▼<orkg:hasResearchContribution>
      ▼<orkg:ResearchContribution rdf:about="https://www.orkg.org/orkg/paper/a7c48312-233b-400b-c0f3-0c296941c6/contribution_ORKG_default">
        <orkg_property:P15051>use of the Open Research Knowledge Graph (ORKG) as such an infrastructure to build and publish an initial Knowledge
        Graph of Empirical research in RE (KG-EmpIRE) whose data is openly available</orkg_property:P15051>
        <orkg_property:P1005>literature review using the ORKG</orkg_property:P1005>
        <orkg_property:P1006>From 570 papers of the IEEE International Requirements Engineering Conference (2000 -- 2022), we extract and analyze
        data on the reported empirical research</orkg_property:P1006>
        <orkg_property:P1006>answer 16 out of 77 competency questions</orkg_property:P1006>
        <orkg_property:P15419>The ORKG is a ready-to-use and advanced infrastructure to organize data from literature reviews as knowledge
        graphs</orkg_property:P15419>
        <orkg_property:P32>unavailability of the extracted and analyzed data from literature reviews</orkg_property:P32>
        <orkg_property:P1005>evaluation against competency questions</orkg_property:P1005>
        <orkg_property:P49000>https://github.com/okarras/EmpIRE-Analysis</orkg_property:P49000>
        <orkg_property:P2005>https://orkg.org/api/rdf/dump</orkg_property:P2005>
      </orkg:ResearchContribution>
    </orkg:hasResearchContribution>
  </rdf:Description>
</rdf:RDF>
</x:xmpmeta>
<?xpacket end="r"?>

```

# 11. Import the FAIR information into the ORKG



The screenshot shows the ORKG website interface. At the top, there is a navigation bar with the ORKG logo, menu items (View, Tools, About), a user profile dropdown (NFDI4DataScience), a search bar, and a '+ Add new' button. Below the navigation bar is a main banner with the text 'Scholarly Knowledge. Comparison' and a sub-header 'The Open Research Knowledge Graph (ORKG) aims to describe research papers in a structured way. In ORKG, papers are easier to find and compare.' A 'Play video' button is also present. Below the banner is a section titled 'Browse by research field' with several red buttons representing different research fields: Arts and Humanities (433 papers - 33 comparisons), Engineering (3403 papers - 351 comparisons), Life Sciences (4145 papers - 197 comparisons), Physical Science and Mathematics (15755 papers - 737 comparisons), and a partially visible 'Social Sciences' button. A dropdown menu is open from the '+ Add new' button, showing three options: 'Comparison' (with a thumbnail of a comparison interface), 'Paper' (with a thumbnail of a paper form), and 'Other' (with a thumbnail of three dots). The 'Comparison' option includes the text 'Create an overview of state-of-the-art literature for a particular topic by adding multiple contributions simultaneously.' The 'Paper' option includes the text 'The add paper form guides you to the process of generating structured data for your paper.' The 'Other' option includes the text 'Add other artifacts, such as datasets, software or general resources.'

1. Log in with your credentials
2. Click “+ Add new”
3. Select “Paper”

## Remark:

ORKG does **not save** the uploaded PDF. It **only extracts** the FAIR annotations embedded in the PDF metadata.

# 11. Import the FAIR information into the ORKG

ORKG View Tools About NFDI4DataScience Search... + Add new

Add paper Upload PDF Enter BibTeX

DOI ?

Lookup

When a DOI is entered, some metadata is automatically filled

Show metadata fields [Click here if you don't have a DOI](#)

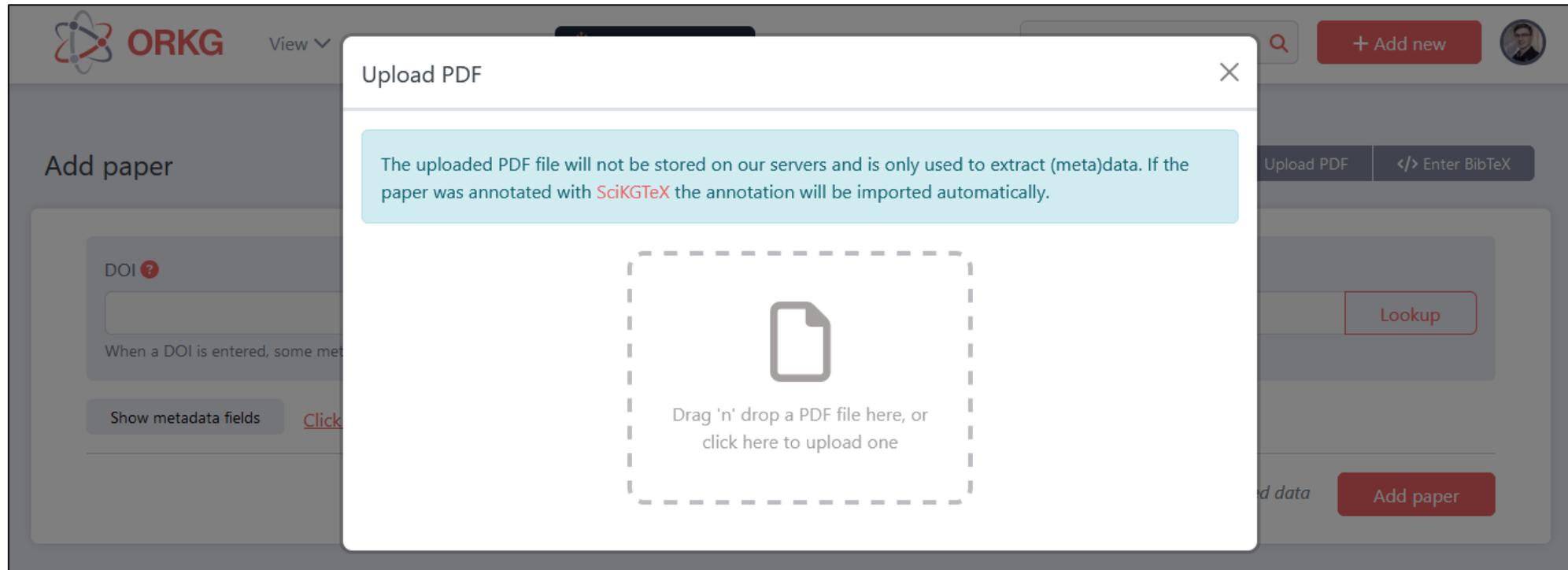
After adding the paper, you will be able to add structured data Add paper

1. Select “Upload PDF”

**Remark:**

ORKG does **not save** the uploaded PDF. It **only extracts** the FAIR annotations embedded in the PDF metadata.

# 11. Import the FAIR information into the ORKG



1. Select or drag your PDF file

**Remark:**

ORKG does **not save** the uploaded PDF. It **only extracts** the FAIR annotations embedded in the PDF metadata.

# 11. Import the FAIR information into the ORKG

ORKG View Tools About NFDI4DataScience Search... + Add new

Add paper Upload PDF Enter BibTeX

DOI  Lookup  
When a DOI is entered, some metadata is automatically filled

Hide metadata fields

Paper title (required)

Research field (required)  Choose

Paper authors

- Oliver Karras
- Felix Wernlein
- Jil Klünder
- Sören Auer

+ Add author

Publication month  Publication year

Published in

Paper URL

After adding the paper, you will be able to add structured data

1. ORKG shows imported metadata
2. Optional: Edit the metadata
3. Select “Add paper” at the bottom

## Remark:

ORKG does **not save** the uploaded PDF. It **only extracts** the FAIR annotations embedded in the PDF metadata.

